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The Global Challenges of the Knowledge Economy:[1] China and the EU

Can Huang and Luc Soete[2]

Abstract

This paper addresses some of the challenges confronting the European Union and China as they build their knowledge economies, and their on-going and possible future actions to address such challenges. Fifty years after the creation of what became the European Union, we argue that there is an urgent need to develop a new European Lisbon Agenda, preparing the EU for globalization. A new and "outward-looking" Lisbon strategy would focus on three key areas: international trade in services, internationalization of research networking, and access to brains and talent. The paper shows that the success of the Chinese economy over the past three decades can be partially attributed to its ability to absorb globally advanced technology and huge flows of foreign investment, its large pool of knowledge and talent, and its enactment of a policy framework that provides incentives to domestic and foreign firms to innovate - a strategy very much reminiscent of Europe's own internal Lisbon agenda. To move further, China needs to overcome the obstacles of regional disparities, transform its industry and deepen industry-academy linkages, which are also unavoidable tasks for the sustainable development of Europe. We contend that the scope for comparative studies of the EU and China, for mutual learning from each other's experience - even for joint initiatives – is substantial.

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Introduction: European integration in a global setting

Economically, the last fifty years of European integration have brought about an unparalleled process of economic development, of social transformation and employment creation. Economic development in Europe has been spurred by the opening up of national markets and the harmonization, still incomplete in many sectors, of the European Single Market; by monetary and fiscal convergence with the introduction of the Growth and Stability Pact accompanying the introduction of the euro; by regional cohesion policies with the transfer of substantial amounts of resources between member states towards less favoured regions and countries; and by a series of subsequent enlargements making the European Union today the largest trading block in the world.

At the same time though, the last ten to fifteen years have also been characterized by an unparalleled process of economic growth at the world level, in actual annual growth terms at a substantially higher percentage than that of the EU, and accompanied by a dramatic expansion of world trade and world wide capital movements. Compared to the enlargement of the EU, the enlargement of the WTO with some of the large BRIC countries has had by any measure a much greater impact on world wide growth or for that matter EU growth. As Richard Freeman put it, the entry of the BRIC countries in the world trade system has, given the size of their potential labour force, effectively meant a doubling of the "world" labour force. The impact on the rest of the world of such a dramatic expansion in opportunities for trading and specialization is likely to involve a long adjustment period, estimated by Freeman at more than thirty years.

It is of course somewhat of a paradox that at the time of the Lisbon summit, with its strong focus on Europe's internal competitiveness, so little attention was paid to this global transformation with the spreading of knowledge to new, emerging economies and the implications that would have for Europe's future position in the emerging global knowledge economy. Since the Lisbon summit in March 2000, it is probably fair to say that the largest part of world wide economic growth has been associated with an acceleration in the diffusion of technological change and in world wide access to knowledge, as opposed to individual countries' domestic efforts in knowledge accumulation. Maybe surprising in view of the particular attention given to domestic, European knowledge accumulation in the Lisbon agenda, most of the recent growth evidence of both the BRIC countries and EU member countries points to the particular importance of the international dimensions of knowledge accumulation. Undoubtedly, and as was actually acknowledged in the Lisbon agenda, the emerging digital technologies and in particular the easy and cheap access to broadband, the world wide spreading of internet and of mobile communication have been instrumental in bringing about a more rapid and more global diffusion of best practice technologies, and in particular more capital and organizational embedded forms of technology transfer such as licences, foreign direct investment and other forms of formal and informal knowledge diffusion, no longer limited to the OECD world but involving now systematically the BRIC countries.

Today after not even a decade in the new millennium, it has become clear that Europe is just one region in the world with a number of specific characteristics which render it particularly vulnerable to the emerging global competition. Those characteristics have become well recognized over the last years, which were, however, already well-known at the time of Lisbon. Demographic factors - including an ageing population in most EU

member states coupled with low fertility rates - are insufficient to sustain European employment levels in the long term. Economic, social and cultural factors with seemingly natural limits to the further scale advantages which could be reaped from further European integration – the European Union given its cultural, language, regional diversity resembles anything but a United States of Europe. And last but not least national, member countries govern in areas which appear today key to global competitiveness, such as education and training, research and development, innovation and entrepreneurship with many overlapping tools, let alone any clear concept of subsidiarity governing European or national versus regional policy making.

The focus in this paper is on the external challenges confronting the EU in turning Lisbon from an inward-looking, "domestic paradigm" into an "international cooperative one" (Courela, 2007). In line with the Lisbon strategy, the focus here will be on policies addressing knowledge creation, use and diffusion, and their impact on economic, social and environmental welfare. This paper is accompanied by similar papers focusing on the political dimension (Mario Telo, 2007), international relations (Álvaro Vasconcelos) and sustainable development (Ian Begg).

In a first section, a brief analytical elaboration is presented on the reasons why the Lisbon agenda in 2000 did not address many of the emerging globalization issues. Viewed in retrospect, Lisbon appears primarily focused on the enhancement of the internal growth dynamics within the EU (Rodrigues, 2002). To some extent, it could be argued today that the Lisbon 2000 summit represented the final, major EU attempt at formulating a set of combined European and national members policy priorities with respect to domestic European knowledge creation and its diffusion, and social and macro-economic policies aimed at bringing about more European growth dynamics. A final attempt at inward-looking integration setting out for the early 21st Century the European dream "to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth region with more and better jobs and greater social cohesion": the crowning, but implicitly also, the coming to an end of 50 years of policy priority to European internal integration.

That process of economic integration could, again with hindsight, be viewed as one characterized primarily by the success and failure of European industrial policy. Industrial policy addressing what was perceived after the second world war as Western and Eastern Europe's central problem compared to the US or the Soviet Union, namely that of *scale*. *Scale* in production as in the case of the European Community on Steel and Coal Mining or agricultural production as in the case of the Community Agricultural Policy. And later on, with the major Delors initiative, *scale* in trade integration and harmonization amongst the EU member countries as in the case of the Single Market. As in the US and Japan, industrial policy shifted in the 70's away from so-called "rust belt" sectors towards new "sun rise" industries such as the semiconductors and electronics industries. It led to the acknowledgement of the strategic importance of R&D investments and European R&D networking and alliances and more recently higher education.

However, as discussed in the second section of this paper, the ICT knowledge paradigm confronted Europe also with new international challenges, which didn't really enter the European policy discussion. In the case of the semi-conductors industry for instance, the growing competition from Asian countries such as China with even bigger scale

advantages than the US, challenged the European integration focus on scale. The semiconductors *scale* advantage which had been greatly enhanced in Europe by GSM mobile phone demand, effectively the killer applications for semiconductor producing firms in Europe in the 90's, became challenged. Even the biggest European alliances, such as the one in Crolles (France) grouping the remaining European semiconductor producers, could not resist the international pressures to outsource manufacturing production to Asia. The remaining semiconductor firms became so-called "fabless" specializing in semiconductor design and development, but no longer in its mass production.

Similarly, in the case of ICT applications in services, Europe appeared confronted with major difficulties in reaping the efficiency gains of such applications. Apart from the negative impact of national regulations and the lack of a single market in services with the final consensus agreement on a revised services directive only achieved in 2006, in many sectors the characteristic increasing return network features associated with the delivery of services appeared impossible to become realized in a European context of 27 member countries with differences, not just in regulatory regimes, but also in languages, cultures, tastes and habits. These ICT and other challenges question to some extent the geographical nature itself of European economic integration. Suddenly, Europe appears to have become much more borderless, its growth and dynamics becoming more dependent on external forces and growth opportunities than on its internal dynamics.

In the third section, we draw, albeit very briefly in just a couple of pages, some of the most striking similarities and differences with the Chinese situation. Maybe surprisingly to a European reader, the Chinese challenges with respect to knowledge creation and knowledge diffusion appear up to a level very similar to those of the EU. The importance of local governments in the Chinese innovation system, result e.g. in a R&D funding system whereby both central and local governments similar to the EU and the EU member states have each their own emphases on funding S&T programs, based on own fiscal revenues. Thus like in the case of the EU Framework Programmes, there are in China central government S&T programs, such as the Key Technology R&D program, the 863 program and the 973 program. However, many others are by and large funded by local governments and enterprises participating in the programs. For instance, the fiscal appropriation from the central government to the Spark program never surpassed 5 percent of total funding in the 1990s, a figure very similar to the percentage of EU R&D appropriation compared to those of the national member countries.

But whereas in the case of the EU, the fiscal diversity between member states in funding R&D is so to say politically embedded in the limits and contours of the economic and monetary union whereby the limits of further fiscal integration are, as it were encapsulated in the various EU treaties[3], the Chinese bottom up, economically driven, fiscal federalization has lead to an accentuation in the regional disparities of R&D funding. Thus, in China's most developed regions, such as the Guandong and Zhejiang provinces, local governments have a much larger R&D budget than their counterparts in the less-developed provinces and regions. Their enterprises and scientific institutions have also more opportunities to receive central and private funding for their innovation activities. Some of those well endowed provincial governments have even set up their own natural science foundation to support basic research in the

[3] Effectively shifting more R&D funding tools to an EU level was actually a central feature of the original European Constitution proposals.

universities and institutions in their area. By contrast, in many less-developed provinces, governments do not have the financial capacity to do so.

In addition to this fiscal federalism, the Chinese political and economic system is also characterized by a strong autonomy of local governments. With the large diversity in development levels of regions in China, the issues which call for attention from policy makers in one region often do not exist in other regions. In areas not regulated by national law, local governments can enact regulations overseeing them in their purview. A typical example with respect to innovation policy is the regulation on venture capital investment. Before a national regulation on venture capital investment came into effect on March 1, 2006, at the local level the Shenzhen, Chongqing and Shenyang municipal government enacted regulations to promote venture capital development in their administrative areas. In this sense, what appeared to be "best practice" innovation regulation in the more advanced regions provided experience for the development of similar practices in the less-developed regions or in nation-wide action.

In short, both the problems confronting existing (in the case of the EU) and growing (in the case of China) inequality between member states/provinces with respect to knowledge creation and knowledge diffusion, as well as the appropriate policy responses in dealing with such diversity suggest that China and the EU can benefit from each others experiences. As argued in section 3, the scope for policy learning is enormous.

We conclude by drawing some broad conclusions as to what all this could mean for the EU's external actions.

Section 1: On the long road to Lisbon

With hindsight, the Lisbon 2000 initiative could be considered as a unique attempt to deal with what could be considered an institutional weakness in the formation of the European Union. Up to Lisbon there had really been only two areas were, in institutional terms, European power was clearly dominant over national member countries power: competition policy and monetary policy.

Competition policy was, and is still, governed, one could argue, by the internal "single market" dynamics leading to a continuous broadening of its influence: a systematic enlargement of the sphere of the working of market forces. One may think of the "services directive" with its attempt at further harmonization of regulatory rules regarding the delivery of services or the European patent proposals. While such broadening of the sphere of market forces to new sectors has resulted in bringing about a major general efficiency enhancing effect across the EU, it has not contributed in any direct sense to the process of knowledge accumulation or innovation improvement within the EU. On the contrary, in areas of research and innovation, competition policy has gradually created growing legal uncertainty with respect to member countries' own R&D and innovation support policies, explaining the Commission efforts over the last years to come up with a new State Aid Action Plan and new rules governing R&D and innovation support policies. In some member countries there is today concern that some of the domestic R&D and innovation support policies might well have been contrary to European competition policy rules.

Monetary policy on the other hand, as implemented by the European Central Bank has put priority on coping with the huge diversity in the EU in growth and inflation pressures. In doing so, there has again been a sheer natural broadening of the influence of monetary policy over domestic member countries' fiscal policies. The Growth and Stability Pact provides Europe with an instrument with which it can determine in purely quantitative terms member countries' fiscal policies. But here too, there is no inherent incentive to promote knowledge and innovation as engines of sustainable growth.

Given these institutional biases, it was not really surprising that the Lisbon agenda of knowledge and innovation capacity building in Europe was by and large dependent on member countries' efforts and willingness to give *domestic* priority to knowledge accumulation in all its facets, including innovation and knowledge diffusion, education and training. Contrary to the two areas described above, this is an area with ultimately little European power over and above member countries.

Furthermore, the relevant policy areas cover a wide spectrum of policy fields ranging from research to education policy, with sometimes little, sometimes growing European involvement (as in the case of the European Research Council), sometimes implemented in member countries at a purely national level, sometimes executed at a purely regional level being governed by regional policies.

All this has to some extent formed the basis of an overemphasis, one might even say a natural obsession, with internal knowledge and innovation accumulation in Europe. It has nourished a process of European cocooning in this area. Thus, European and national policy concerns have addressed first and foremost the functioning of the European research area, the achievement of the Barcelona targets, the comparisons of

best practice innovation policies amongst member countries or regions, and many other local knowledge accumulation and diffusion bottlenecks. In the meantime though, the knowledge and innovation world outside of the European borders has changed substantially and is likely to continue to do so in the near future.

For sure in the future too, there is likely to remain a continuing concentration of knowledge creation activities in a small number of regions in the world which will be matched by persistent international differences in the share of resources devoted to science and technological efforts and R&D in particular. The EU, with the US and Japan, should undoubtedly attempt to remain part of that region, with China likely to overtake it in the coming decade (see Figure 1: Total Number of Researchers (Full Time Equivalent) in Different Countries, 2003 and Figure 2**:** China's R&D Expenditure as a Percentage of the R&D Expenditure of the US, EU-25 and Japan, 1991–2003 (Percentage)).

Yet today, contrary to the old Lisbon 2000 view, it is no longer the concentration of such efforts in a particular region of the world which is key to economic growth and international competitiveness than the broader local organizational, economic and social embedding of new technologies and innovations and the way they unleash or block particular specific development and growth opportunities.

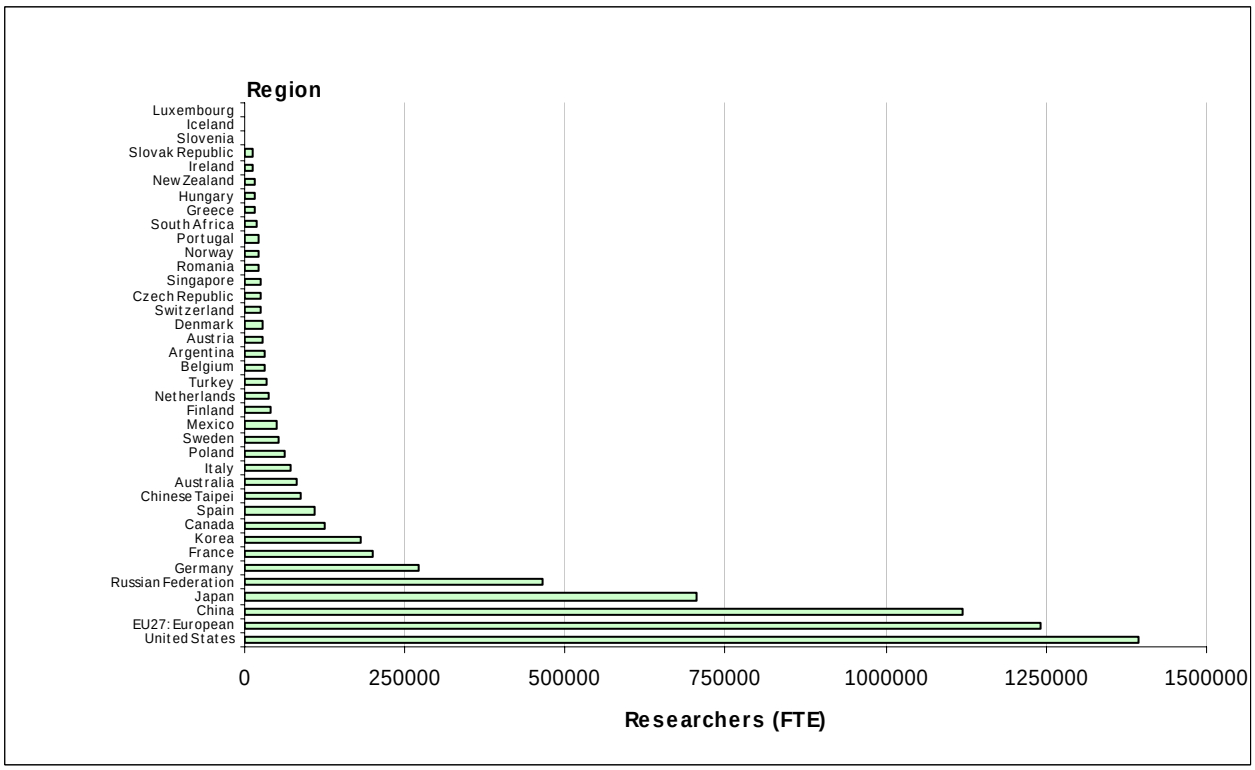
As has become recognized in the endogenous growth literature[4], the innovation policy challenge appears ultimately closely associated with levels of development. In a high income, developed country context, the innovation policy challenge seems increasingly directed towards questions about the sustainability of processes of "creative destruction" within environments that give increasingly premiums to insiders, to security and risk aversion, and to the maintenance of income and wealth. Most of the EU's continental member countries seem to be confronted with that challenge.

In an emerging, rapid growth catching up environment, as in the case of many of the new EU member states, but also China, India, Brazil or Russia, the challenge appears directed towards industrial science and technology policies bringing also to the forefront the importance of engineering and design skills and accumulating "experience" in particular. The Dutch Advisory Council on Science and Technology Policy has coined those policies as "backing winners" policies, with the emphasis on backing as opposed to picking winners. Here the more intensive international competition following the international integration of those countries in the EU or the WTO, has put significant new competitive pressures on sectors and firms of those countries.

And last but not least there are the vast majority of developing countries which appear characterized by "disarticulated" knowledge systems, with bits and pieces of the knowledge system operating as isolated islands with little or no connection to the rest of the economy and higher education systems of generally speaking poor quality. The innovation policy challenge here is in its complexity of a completely different order of magnitude.

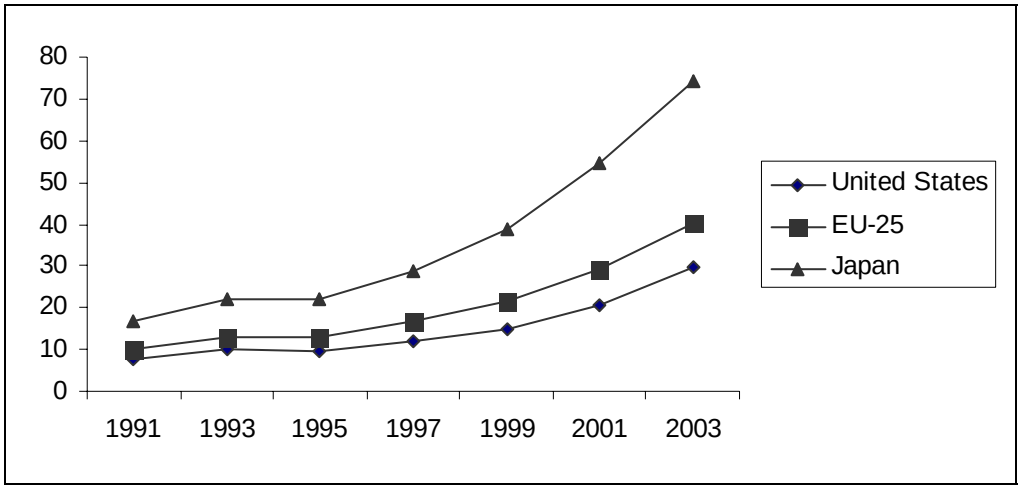
[4] This view of the philosophy and aims of innovation policies differing amongst countries according to their level of development, reminiscent of many of the arguments of the old infant industry type arguments has now become popular in the endogenous growth literature. See Aghion and Howitt (2005).

Figure 1: Total Number of Researchers (Full Time Equivalent) in Different Countries, 2003.



Source: Calculated on the basis of various UNESCO and OECD sources (2003). Estimates made by Nico Rasters, UNU-MERIT.

Figure 2: China's R&D Expenditure as a Percentage of the R&D Expenditure of the US, EU-25 and Japan, 1991–2003 (Percentage)



Source: OECD, Main Science and Technology Indicators (various years).
Note: 1. All data are calculated by the OECD with purchasing power parities.
2. The data are obtained from the National Science Foundation (2006).

Section 2: Opening up Lisbon: towards an external knowledge policy perspective

In this second section, we select a number of areas which appear at first side most in need of a further opening up of Lisbon. They are, in our view all key to the Lisbon knowledge agenda: the information society with its heavy dependence on network service activities, research which increasingly has become a borderless activity, and last but not least the international search for brains and talents. Obviously there are many others not in the least the challenges with respect to sustainable development whereby issues such as climate change and the use of sustainable energy resources rely heavily on global responses. These latter issues are not addressed here.

A. European network services and the global level playing field

As already highlighted in the introduction, Europe with its differences in cultures, languages, political and fiscal governance diversity, historically grown institutions, habits and tastes has always been intrinsically at a disadvantage with respect to reaping the scale advantages of the internal market in services and in particular network services. One may think of finance, insurance and business services, transport, wholesale and retail services, telecommunications, media and advertising services as well as many public services ranging from health to education. All these service sectors have been literally transformed by the application of information and communication technologies. At the time of the Lisbon summit also the height of the dot.com boom, a lot of attention was given to the enormous growth potential of those service sectors.

Alongside the European internal discussion about opening up member countries' national markets along the lines of the successful mobile communications liberalization process, there was also at the international level, a discussion within the Doha round trade negotiations of the so-called Singapore "new regulatory" issues: the setting world wide of standards for public procurement, of competition policy, investment policy and trade facilitation. Those rules were strongly supported by most European service network firms as they would facilitate the access to emerging markets for those firms in some of the most rapid growing high tech-service markets world wide such as telecom services, but also financial services, even public utility services. Not surprisingly, the European Commission took a very positive trade liberalization position in the run up to the Doha round trade negotiations on those issues, whereby in the typical quid pro quo fashion of trade negotiations, one was prepared to give in on agriculture tariffs in favour of trade liberalization in these more dynamic, innovative, service sectors[5].

[5] In Multilateral trade negotiations under the reciprocity rule, exporters' will find that their access to foreign markets depends on the openness of the home market. "Under the reciprocity rule, trade policy formulation appears ultimately a political contest between import competitors and exporters. The central point of Multilateral Trade Negotiations is to create a domestic political constituency in favor of openness where none had existed before by giving exporters a reason to lobby governments in favor of home market liberalization. Hence, in the world of international trade negotiation exporters defend *offensive interests*, import competitors *defensive interests*." (Toro, 2006) Under the Doha round which started in 2001, the EC first took an offensive stand in the agenda setting phase and then shifted after the so-called Geneva 2004 meeting towards a much more blocking stand.

The underlying motivation for trying to open up those external service trading relationships beyond the internal single market but directly at the world WTO level was to some extent illustrative of the underlying scale problem at the European level in each of those service network sectors. Indeed, the characteristic increasing return features associated with the delivery of many of such high-tech network services, can not always become fully to fruition within the context of a EU with 27 member countries each not just with different regulatory regimes governing some of those networks, but also with different languages, different cultures, different tastes and habits. From this perspective, the slow progress on the internal market front with respect to services is actually illustrative of the intrinsic difficulties to take full advantage of scale in many service sectors. By contrast, the international trade negotiations and in particular the trade liberalization demands with respect to the "new regulatory issues" did provide a welcome complement for European firms to realize at the *international* rather than just at the European level, those increasing returns, scale advantages. The old language and cultural links, dating sometimes back to colonial times of many individual EU member states with emerging and developing countries, represented for many of those EU member states a sheer natural, much more straightforward opportunity for the expansions of such service based markets in an international global direction.

From this perspective one still underestimates the way historically grown international links between countries on the basis of old established trade and foreign investment relationships have built strong cultural, business and trust relationships. One may think of Ericsson's or Saint-Gobain's presence in China going back to the 19th Century; Belgium's involvement in constructing Chinese railways early last Century, and of course the British and Portuguese presence in Hong-Kong and Macao.

The ultimate decision to exclude those Singapore issues from the Doha trade negotiations taken in 2004, not just shifted the EC's international trading position into a more defensive one, having now to trade for tariff reductions in developing countries in non-agriculture manufacturing in return of tariff reductions at home in agriculture, it also redirected policy makers' attention back to European internal trade integration issues such as the service directive while indirectly having eliminated some of the much more natural global growth opportunity for some of those high tech service sectors which had been at the centre of the Lisbon knowledge agenda.

B. From the ERA to "Recherche sans frontières"

A second area where internal European concerns took over in the aftermath of Lisbon was of course investment in knowledge (R&D and innovation) accumulation in the EU and its various member states as exemplified by the so-called Barcelona 3% target approved in 2001. The latter target centres on the strengthening of the geographical determined spill-overs of European, national and regional R&D and Innovation efforts (Muldur et al., 2006). However, precisely because of the much higher risks involved in developing new products for global markets, firms today will often prefer to license such technologies or alternatively outsource locally but also internationally the most risky parts to small high tech companies which operate at arms length but can be taken over, once successful. Not surprisingly in most EU countries, the large R&D intensive firms appear today less interested in increasing their R&D investments in Europe than

in consolidating them or where possible reducing the risks involved in carrying out R&D by collaboration with others sometimes through publicly sponsored or enabled programmes (SEMATEC and IMEC in micro- and today nano-electronics[6]), or even through so-called open innovation collaboration.

Not surprisingly, many small, traditionally high R&D intensive EU member countries have no longer witnessed growth, but sometimes even a decline in their privately funded R&D intensity over the last four to five years with ultimately little or no relationship to their economic performance. From this perspective, the central question appears to be whether the benefits of knowledge investments can be appropriated domestically or will "leak away" globally. In the catching-up growth literature, it was already emphasized how this phenomenon would be characterized by lagging countries benefiting from the import, transfer of technology and knowledge, formally and particularly informally. As a logical extension, in the current global world economy, it seems obvious that increasing R&D investment is unlikely to benefit only the domestic economy. This holds *a forteriori* for the small EU member countries, but is increasingly valid for all EU countries.

Thus, as Meister and Verspagen (2003) calculated, achieving the 3% Barcelona target in the EU by 2010 will ultimately not reduce the income gap between the EU and the US, the benefits of the increased R&D efforts not only accruing to Europe but also to the US and the rest of the world. In a similar vain, Griffith, Harrison and Van Reenen (2004) illustrated how the US R&D boom of the 90's had major benefits for the UK economy and in particular for UK firms having shifted their R&D to the US. A UK firm e.g. shifting 10% of its R&D activity to the US from the UK while keeping its overall R&D expenditures at the same level, would witness an additional increase in productivity of about 3%, an effect which appeared to be of the same order of magnitude "as that of a doubling in its R&D stock" (Griffith et al. 2004, p.25). In short, the link between the location of "national" firms' private R&D activities and national productivity gains appears today increasingly tenuous.

The same holds for universities and other public research institutes. Ten years ago already, one of us (Soete, 1997) pointed to the inherent knowledge "diversion" implications of the European research networking and the likely impact this could have on European research "cocooning", as pursued e.g. through the European Framework Programmes. Over the years the gradual broadening of research priority areas to include both local as well as global long term issues has raised increasingly questions about the European territorial nature of such EU sponsored research and has ultimately led to the European Framework Programmes becoming increasingly shared and open in

[6] A look at the world's nanotechnology publications (indexed by *Web of Science*) highlights the increasingly global nature of nanotechnology research. In 2006 the U.S produced 26 percent of the world's nanotechnology publications, China and Japan respectively 19 percent and 11 percent. By contrast the large European countries such as Germany, France and the U.K. accounted for respectively 9, 6 and 5 percent. The increasingly dispersed global nanotechnology R&D activities and the strengthened commitments of various national governments to nanotechnology funding indicate that nanotechnology R&D in Europe will not advance in an isolated way, but will have to rely on international cooperation and collaboration.

participation and external co-funding to researchers from non EU countries. The next step should be a complete opening up.

Indeed, in many research areas, European welfare will in the long term be directly influenced not so much by the development of local knowledge through national of EU sponsored research programs but by global access to such knowledge, the development of joint global standards and the rapid world-wide diffusion of such new technologies to other, non-EU countries. One may think of energy saving technologies, research on sustainable development and climate change, health and the spreading of diseases, food safety, security, social sciences and humanities, etc. In all these areas, the urgent need for global solutions to safeguard in the long term European welfare, warrant a more open research approach less concerned with the local, national or European returns to European tax payers' money than with the search for shared solutions to common problems.

C. The global search for talent

The third area in need of external action is possibly the most challenging one. One of the most fundamental differences between the EU and the US and many emerging economies is the ageing of its highly skilled work-force. Europe could possibly learn in this respect more from countries such as Japan and Russia with similar demographic challenges.

The international dimension of a future European Lisbon education and employment strategy will have to deal with the growing international competition for access to brains. Access to brains should be understood here in its broadest definition: access to talent as an essential ingredient in research, innovation and entrepreneurship; access to more routine technical skills as one element in a broader strategy to tackle growing labour shortages in particular skill categories; and access to more personal skills as Europe's population grows older and the demand for health and care support services will consequently grow dramatically.

Access to brains has of course been an essential historical feature of development and knowledge transfer within Europe and between Europe and the rest of the world. Many European countries have moved from a situation of emigrating countries to immigrating countries, with Ireland probably as the most extraordinary case. At the same time, the migration of skilled labour from developing countries to developed countries has increased significantly. The issue has been referred as 'brain drain' as well as brain exchange or brain circulation. 'Brain circulation' is defined as the cycle of moving abroad to study, then taking a job abroad, and later returning home to take advantage of the skills acquired abroad to enhance domestic job opportunities. "Brain exchange" is defined as a two-way flow of expertise between a sending country and a receiving country. Where the net flow is heavily biased in one direction, the term "brain drain" has been used.

Brain drain acts as a double-edged sword on poverty: it increases further inequality at home and slows down economic growth. On the other hand there is also a positive effect of migration prospects on human capital formation itself in the sending country.

The possibility of emigrating to higher wage countries may stimulate persons to pursue higher education in the hope of improving their expected wages abroad. This might cause sending countries to benefit from skilled emigration because it induces the remaining native population to pursue higher education, and might ultimately lead to a process of brain circulation, as in the case of Korea in the past and China today.

From the point of view of receiving countries though, and the EU in particular, skilled migration is always important not just for the growth of the economy but also because of more general benefits like entrepreneurship, the contributions to an increasing demand for goods and services, attraction of new capital, etc. The foreign environment offers new alternative possibilities for initiative taking and entrepreneurship. In short immigration, the external appeal for brains and talent should be fully part of the Lisbon agenda, as should be the challenges it raises in some of the sending countries (one may think of the large numbers of nurses emigrating from South Africa).

Section 3: Opportunities and challenges for mutual learning: China and the EU

As argued in the Introduction, in a certain way China resembles the EU both in terms of its political and economic system, and in terms of the nature of the policy challenges it faces. However, as we will discuss below the Chinese policy actions to tackle these challenges are not always similar as those implemented in the EU. In this sense the similarities and diversity between China and the EU in the policy responses to the challenges of the emerging global knowledge economy provide ample opportunities for mutual learning. Given the limited space within the framework of this paper, we limit ourselves to three particular major challenges directly related to the knowledge economy which China is currently facing and the policy responses that have been gradually introduced over the last decade.

Again we do not focus here on some of the most urgent issues with respect to sustainable development, even though they provide possible the most direct and immediate opportunities for mutual learning and joint initiatives both with respect to knowledge creation and knowledge diffusion. It has been recently argued (Economy, 2007) that environmental degradation and pollution cost the Chinese economy between 8 and 12% of gross domestic product annually. As the recent flooding in the UK and burning in Greece disasters illustrated, Europe too is suffering from climate induced natural disasters and environmental degradation. Achieving sustainable development is a major common concern, but it will be clear that in the case of a rapidly growing economy such as China, the challenge will be much more formidable.

A. Regional disparity in growth and development

Similar to the EU, with its combined dual efforts of public knowledge investments at individual member state level and at the European level through the funds allocated through EU-wide research, innovation and economic development programmes (such as the Framework Programmes, the ERC, Regional cohesion policies, etc.), local governments alongside the central government do play an important role in the Chinese innovation system. Indeed, the Chinese fiscal system is a federal tax system: national and local taxes are collected separately by different tax bureaus and central and local governments have each their own policies of public support for research, innovation and economic development. Such fiscal federalization unavoidably leads to strong regional disparities in terms of R&D funding. In an economically developed region, local governments will have larger R&D budget than the counterparts in the under-developed regions. The Chinese political and economic system is in other words strongly characterized by the autonomy of local governments. For local affairs which are not regulated by a national law or regulation, local governments can enact regulations and oversee them in their purview.

Fiscal federalism and autonomy of local governments in funding innovation activities are likely to bring about a segmentation of S&T and innovation resources, as is manifested in the differences in availability of and access to large scientific apparatus, experiment instruments and databases. Experimental instruments purchased by different institutions and organizations in China are typically not used to be shared with others. Scientific database and data are isolated by the institutions which created or purchased

them. The segmentation of the S&T resources and infrastructure inevitably gives rise to replicate purchase and waste of limited funding. The Ministry of Science and Technology (MOST), National Development and Reform Commission, Ministry of Education and Ministry of Finance launched an initiative in 2004 which aimed to integrate all investment on S&T infrastructure and promote the efficient usage of existent S&T resources. This so-called "S&T infrastructures and Platform Development" initiative built six platforms to promote shared usage of research centers, large scientific apparatus and experiment instruments, scientific databases and literature, share technology transfer project information and build up network for scientific research (Table 1).

Table 1 The Initiative of S&T Infrastructure and Platform Development of MOST

Platform	Characteristics
Platform for shared usage of research centers and large scientific apparatus and experiment instruments	Collect the information of scientific apparatus which are worth more than 500 thousand RMB each and promote the shared usage of them; Manage the current research centers in line with the principle of "open, mobile, unity and competition"; Build up a network of field observatories; Harmonize the technological standards and inspection systems.
Platform for shared usage of natural resources	Promote shared usage of resources of germ plasm of plant and animal, microorganism, human and animal genetic resources, specimen and cell bank etc.
Platform for sharing scientific data and database	Construct data centers to promote sharing the scientific data in the field of meteorology, topography, earthquake, hydrology, forestry, oceanography, geology etc.; Establish 11 websites and databases for the research in different fields.
Platform for sharing scientific literature	Promote the shared usage of scientific literature, patent information and technological standards.
Platform for technology transfer	Establish an information network of available opportunities of technology transfer. Establish a network for disseminating information about technological standards.
Network Platform for scientific research	Build up a network supporting the abovementioned platforms; Establish a connected computation system; Establish a telecommuting network system for scientific research; Set up a on-line museum for science education; Establish a website providing information service related to science and technology.

The similarity in both the purpose and policy tools proposed in the European Union under the different Framework Program (FP) with its by now well accepted concepts such as the so-called Technology Platforms (under FP6) or the new Joint Technology Initiatives (under FP7), with the proposed Chinese MOST platform tools is striking. There is consequently a lot to be learnt from comparative evaluation exercises between the EU and China of such policy tools aimed at more research networking and less research overlap. There is also scope for analyses of best practice policies in some of those areas.

Addressing the growing regional disparities seems form this perspective a common policy concern. The EU is unique in having addressed the enormous diversity in income and development levels through a system of structural funds being made available for the least developed regions for infrastructural and intangible investments. It has to do so the availability of its own financial arm, the European Investment Bank. The use of such funds has effectively meant the transfer of resources between its member states with the explicit purpose to help less favoured regions to develop and adjust their industrial structure. The gradual enlargement of the EU has undoubtedly put this system under strain, but it has remained a unique policy tool, going beyond the direct economic advantages for least favoured regions, but also contributing to the social cohesion of those regions by reducing the emigration pressures towards richer, more economically successful regions, and so also maintaining some of the regional cultural identities. In this sense the EU experience is very different from that of the US: internal migration within the EU has remained by and large limited to the most skilled part of the population, including students. At the same time, the regional diversity both in language, taste and habits discussed in the previous section on network services has remained a major factor behind the lack of mobility within the EU. In short, whereas the economic catching up of the new member countries has been spurred by economic integration and the inflow of private foreign direct investment, European regional policies have helped offset some of the resulting emerging regional disparities within and between EU member countries. In doing so they have helped reducing some of the resulting migration pressures while at the same time strengthened the local identity of those regions with the European Union.

With the significant growth in disparity in economic development emerging in China across its regions and provinces following the rapid catching up of the most well endowed and well located regions to world productivity and income levels, there is scope here for policy learning from the European experience. The latter for sure has also been confronted with major difficulties, but is still one of the unique corner stones of the European economic integration process as opposed to other regional economic trade or monetary integration zones.

B. Transforming low-wage manufacturing sectors to innovation-based industries

The success of the Chinese economic reforms and the growth of China's national innovation capability since the 80's can be partly attributed to the policy of welcoming foreign direct investment (FDI) (Liu and Wang, 2003; Buckley et al., 2002). However, many critics pointed out that the huge inflow of FDI also came at a price namely that China is heavily dependent on foreign technology and that the rapid expansion of

Chinese exports over the last decade is largely based on the growth of low-wage manufacturing sectors (Gilboy, 2004). Actually, in 2002 China became the world's largest recipient of FDI, receiving nearly $53 billion (OECD, 2003a). China attracted FDI by providing physical and institutional infrastructures, as well as fiscal incentives. The Chinese central government has more or less continuously implemented tax advantages and deduction policies targeting foreign investors, but has gradually shifted the target of preference fiscal policy from low-tech and labour-intensive sectors to high-tech manufacture and service sectors. For example, in July 2003 MOST and the Ministry of Commerce developed a list of favourable high-tech products where FDI would be encouraged. In July 2007, the Ministry of Commerce and Central Administration of Customs amended the list of low-tech commodities whose production would be restricted in China. The amendment of the list limits the development of foreign firms engaged in low-tech manufacturing business in the eastern coastal area, but promotes the development of domestic manufacturers in the central and western regions, where the economy is relatively under-developed. The number of goods in the previous list was merely 394, but it was increased to 2247 in the new version of the list. The amendment marks a drastic change of the Chinese policy towards the trading of low-tech processing industry goods and sent a clear signal that low-tech FDI is no longer favourable in China any more.

In addition to regulating foreign investment, the Chinese government strengthened its support to the innovation activities carried out in enterprises. The 863 program, as one of the main three S&T funding programs supported by the central government, increasingly provides more funding to the projects conducted in the industry after 2001. In 2001, 14 percent of program funding went to enterprises. However, in 2004, the ratio increased to 35.3 percent. The prevalent business support structures such as science parks and incubators also now exist widely in China. By 2002, at the national level alone over 400 business incubators and 53 high-technology development zones had been developed through governmental support, mainly through the Torch Program. In 2005, 41990 enterprises operated in the 53 national high-tech development zones across the country, hiring 5.2 million employees and achieving an industrial added value of some 682 billion RMB. The R&D expenditure by the enterprises in the zones was 80.6 billion RMB, accounting for 2.8 percent of their sales value. MOST estimated that about one third of China's R&D expenditure was spent on the projects run in the development zones.

To finance innovation, China also aimed to establish a viable financial system, and particularly a venture capital system, to support technology-based Small and Medium sized Enterprises (SMEs). There was no comprehensive regulation or law overseeing domestic venture capital investment in China until 2006. Meanwhile, some legislative proposals for venture capital law were submitted to the national legislation authority, and at the local level the Shenzhen, Chongqing, Shenyang municipal government enacted some local regulations to regulate and promote venture capital development in their administrative areas. On March 1, 2006, Provisional Regulation on Venture Capital Investment enacted by 10 ministries and central government agencies under the coordination of the National Development and Reform Committee came into effect. It was the first Chinese nation-wide regulation on venture capital investment and enterprises, with an explicit objective to promote the development of venture capital and SMEs, particularly high-tech SMEs.

Very recently local governments and state-owned organizations started to play an active role in establishing introductory fund to support venture capital investment. China Development Bank and China-Singapore Suzhou Industrial Park co-invested 1 billion RMB to form a venture capital fund in March 2006. Shanghai Pudong district municipal government set up a 1 billion RMB fund to support venture capital investment in Pudong district. The funds are not used to invest directly in start-ups, but to co-establish new funds in collaboration with private capital. In a new fund, the proportion of the funding from Pudong government in principal will not surpass 33 percent. The Pudong government did not aim to profit from the operation of the fund, instead, it meant to leverage and attract private capital to invest in venture capital projects in Pudong district.

Compared to the difficulties of the EU in progressing alongside its Lisbon goals and the soft policy tools at its disposal with respect to the different member states such as the Open Method of Coordination, the voluntaristic Chinese policy measures taken over the last couple of years in trying to shift its economy in the direction of more value added high tech sectors, highlight some of the intrinsic advantages of a command economy, which are of course not available within the context of the EU. However, some of the Chinese policy measures with respect to the nature of FDI or the indirect involvement with the creation of a financial venture system, point to missed opportunities within the EU in using more effectively both its regional structural funds in preventing e.g competition between regions in attracting FDI and in using more effectively the financial instruments it has at its disposal such as the EIB. In short, there are, despite the enormous difference in the nature of the economic system, lessons to be learnt from the Chinese approach to its transition to the knowledge economy for Europe.

C. Deepening the linkage between industry and academy in innovation activities

Strengthening the industry-academy relationship was prioritized in the agenda of the Chinese policy making quite early on, already in the late 80s. The government designed the so-called push- and pull-side policies to develop specific linkages between industry and academia.

On the one hand, the “push-side” policy executed in the 1980s gradually reduced the government’s budgetary appropriation to the S&T institutes. This strategy succeeded to force institutes to turn towards enterprises to earn revenue. The technical service provided to enterprises and the joint R&D projects financed by industry became more important to S&T institutes because they brought in an increasing proportion of the total revenue of institutes. Xue (1997) reported that the ratio of government appropriation to the budget of S&T institutes decreased by 5 percent on average each year from 1986 to 1993. After 1985, S&T institutes, especially those doing experiment and development were encouraged to merge into enterprises. The newest round of reform after 1999 even went further to transform hundreds of S&T institutes into enterprises or non-profit organizations (Huang et al., 2004). Meanwhile, the government concentrated its funding on the unchanged institutes that primarily conducted basic research.

On the other hand, the “pull-side” policy focused on the establishment of the intermediary organizations which facilitated the technology transfer from academia to industry. The transfer was promoted by the “Technology Contract Law” taking effect on

Nov. 1, 1987 and the subsequent relevant regulations. After twenty years' development, a national system of intermediary organizations at the national, provincial, municipal and county levels is now relatively well established. It consists of technology markets, productivity promotion centres and technology consulting organizations, etc. In the end of 2004, more than 1500 technology markets at the different levels operated in China. There were more than 1200 organizations established responsible for registering and certifying technology transfer contracts. Over the past decades, the contract value registered in technology markets grew from 700 million RMB in 1984 to 123.4 billion RMB in 2004, at an annual rate of 15 percent. In addition, the spin-off enterprises were also strongly promoted by the government. Chinese spin-off enterprises showed particular dynamism in their access to new technology, efficient corporate governance, aggressive business strategies and strong learning capabilities (Lu, 2001).

Like in the EU, joint technology centres have been promoted more recently by the government as a means of strengthening the innovation activities in enterprises and improving the industry-academy relationship. An initiative of 2007 led by central government agencies under the coordination of MOST established four R&D and innovation consortia in the sectors of steel, energy, agriculture equipment and exploration of coal mines. The members of the consortia included 26 large enterprises whose revenue added up to more than 900 billion RMB, 18 top universities and 9 research institutions. The government intended to upgrade the industry-academy cooperation in the four sectors from the loose and simple form of contracting projects to more sophisticated forms of strategic alliances. The consortia would establish joint R&D funds and leverage the research centres affiliated to develop critical technologies addressing the challenges that the sectors were facing.

The Chinese innovation policies outlined above are representative of the efforts of the government in designing and implementing effective innovation policy to promote economic and social development. It is interesting to compare at this stage some of those policies with those pursued in the EU, as in the latter case the innovation policies implemented in the different member states have been extensively summarized and systematically benchmarked.

On the basis of the EU's "Trend Chart on Innovation in Europe" it is possible to provide a general and succinct overview of the differences between Chinese and EU countries' innovation policy practice (Table 2). As an informative background, we have summarized in Table 3, a couple of selected R&D and innovation indicators highlighting the differences and similarities between China, Russia, The EU, the US and Japan.

Table 2: Comparison of Innovation Policy in China and the European Union Member States

The EU Trend Chart Innovation Policy Classification System		Examples of Policy Practices in China
Policy Category	Policy Priority	
Fostering an Innovation Culture	Education and initial and further training	Regulations on Degrees (1980), Compulsory Education Law (1986), Teachers Law (1993), Education Law (1995), Vocation al Education Law (1996) and Higher Education Law (1998) demonstrated the Chinese government's legislative efforts since the 1980s. "211 Project" and series of award and training programs including Cheung Kong Scholars Program constituted the recent policy actions. However, the education and training in China were still insufficiently invested. The further discussion is seen in the section 3.3.1.
	Mobility of students, research workers and teachers	Policy was co-developed by Ministry of Education and Ministry of Personnel to support foreign experts to work in China, to attract overseas Chinese students and scholars to return, and to encourage the placement of Ph.D graduate for post doctoral research in enterprises.
	Raising the awareness of the larger public and involving those concerned	China's legislative authority passed Dissemination of Science and Technology Knowledge Law (2002). The government launched the tax preference policy for institutions whose main function is disseminating S&T knowledge. Grants were provided to fund the project of increasing public awareness of S&T.
	Fostering innovative organizational and management practices in enterprises	Not Available.
	Public authorities and support to innovation policy-makers	Not Available.
	Promotion of clustering and co-operation for innovation	Many of the strategies are developed by local governments. For example, the Shanghai municipal government cooperated with other neighboring provinces in the Yangtze river delta for coordinating the development of the industrial clusters in the region. The similar practice is found in the Pearl river delta region embracing Guangdong province, Hong Kong and Macau.

Table 2 (Continued)

Establishing a Framework conducive to Innovation	Competition	Enactment of Unfair Competition Law (1993), Protecting Consumer's Rights and Interests Law (1993) and Regulations on Anti-dumping and Anti-subsidization (1997), Price Law (1998) revealed the government's legislative efforts. However, the young competition policy regime needs to be improved and strengthened (Lin, 2003).
	Protection of intellectual and industrial property	MOST issued several regulations on IPR protection and exploitation. State Intellectual Property Office launched the projects to strengthen the public awareness of IPR protection. However, the IPR policy in China needs to be restructured and improved. The further discussion is seen in the section 3.3.2.
	Administrative simplification	The regulations of simplifying administration were launched to encourage creation of Newly Technology Based Firms and attract FDI.
	Amelioration of legal and regulatory environments	China's Legislative actions covered the field of IPR, S&T and education etc. The further discussion is seen in the section 3.2.5.
	Innovation financing	The Innovation Fund for Small Technology Based Firms was established.
	Taxation	Tax preference policy was implemented to provide incentive to create newly technology based firms and attract FDI. However, the current tax preference policy for encouraging innovation in the established enterprises did not achieve satisfying performance (Wu, 2003).
Gearing Research to Innovation	Strategic vision of research and development	The Chinese central government launched the "2006-2020 Chinese National Science and Technology Development Strategy" in March 2006.
	Strengthening research carried out by companies	Some tax preference policies specifically for some industry sectors were implemented, such as the policy encouraging investment in integrated circuit manufacture sector. However, the effect of this type of fiscal policy is weak according to Wu (2003). 863 Program increasingly supported industry R&D. In 2002, 30 percent of the projects financed by the program are implemented in the enterprises (863 Program, 2004).

Table 2 (Continued)

	Start-up of technology- based companies	Numerous policies aimed to promote science parks and incubators and attract overseas Chinese to set up start-up in China.
	Intensified co-operation between research, universities and companies	Four R&D and innovation consortiums in the sectors of steel, energy, agriculture and exploration of coal mine were established in 2007 with the coordination of central government.
	Strengthening the ability of companies, particularly SMEs, to absorb technologies and know-how	Enactment of Small and Medium Enterprise Promotion Law (2002) and regulations on venture capital development. Establishment of the Innovation Fund for Small Technology Based Firms (IFSTBF).

Source: European Commission (2000b, 2001b, 2002d).

Table 3: Science and Technology Indicators for China and Selected OECD and non-OECD Countries

	China	Russia	EU 15	Japan	US
Gross Expenditure on R&D (GERD) (Million Current PPP US Dollars)[1]	72076.8	14190.4	162813.3	96532.3	252938.5
GERD as a Percentage of GDP[1]	1.29	1.24	1.93	3.09	2.82
Total Researchers per Thousand Total Employment[1]	1.1	7.5	5.8[2]	10.2	8.6[3]
Percentage of GERD Financed by Industry[1]	57.6[2]	32.9[2]	56.2	73.0	68.3
Percentage of GERD Financed by Government[1]	33.4[2]	54.8[2]	34.5	18.5	26.9
Business Enterprises Expenditure on R&D BERD (Million Current PPP US Dollars) [1]	44099.2	9915.7	105121.2	71119.1	188122.8
BERD as a Percentage of GDP[1]	0.79	0.87	1.06[2]	2.25	1.92
Number of "Triadic" Patent Families Per Million Population[4]	0.055	0.490	35.897	89.400	52.712
Number of Patents Applications to the EPO in the ICT Sector Per Million Population[4]	0.031	0.320	35.313	60.810	40.337
Number of Patents Applications to the EPO in the Biotechnology Sector Per Million Population[4]	0.008	0.095	5.341	4.691	9.634

Source: OECD (2003c).

Note: 1. The data for the non-OECD countries without the superscript are the year of 2002. The data for the OECD countries without superscript are the year of 2001.

2. The data are for 2000.

3. The data are for 1999.

4. The data are calculated by the authors. The patent data are for 1998. The Data of Population (1998) except for EU 15 and OECD Average are from World Bank *World Development Indicators (WDI)* database Data Query. The data of EU 15 and OECD Average are from World Urbanization Prospects, the 2001 Revision, United Nations Population Division.

As illustrated in Table 2, some areas of China's innovation policies are today well designed; in other areas few policies have as yet been executed to complement the well functioning ones so as to further enhance the country's innovation performance. Two areas stand out: human resources and intellectual property.

Education and Human Resources

Directed by the so-called principle of "economic rationalism", China's education reform since the 1980s through the decentralization of the financial structure and the diversification of financial resources has not led to increase the lingering ratio of public education investment to total public expenditure. Moreover, the decentralization and diversification strategy has given rise to unbalanced education development across the eastern and western regions, and between urban and rural area. All of these[7], exacerbate the development of China's human capital resources and limits the innovation performance of the country in the long run. Furthermore, the gradually declining ratio of education appropriation of central governments to that of local government reveals that local governments came to assume greater responsibility of education investment than before. The crucial decisions such as whether to invest in education, how much to invest, in which areas: primary, secondary or tertiary education, depended much on local government's budget plan and the political will of the local leadership. Inevitably, the regional and rural-urban discrepancy of education development was widened given that after the 1980s the economic growth rates varied to a great extent across different regions and also between rural and urban areas (Zhang, 2002; Wang, 2002).

The EU countries are of course far ahead of China in the field of the amount of resources devoted to education and human resources development, as reflected both in quantitative indicators and the policy focus. But, again there are clear similarities between the problems confronting China and the EU. Education has remained in the EU the sole responsibility of member states with substantial differences in the amount of public resources devoted to education and more generally human resource development, particularly when some of the richer Nordic Scandinavian countries are compared with some of the new entrants such as Romania and Bulgaria. Furthermore in many European countries the participation of women and minority groups in higher education is still low. As discussed in the previous section, the EU is also confronted with major demographic problems which question its long term growth and the long term sustainability of the availability of its human resources.

[7] As mentioned before, thanks to the Chinese government's effort in past decade, the education legislative system was already established early on in China. However, both government and non-government parties, including school, students and parents, frequently challenged these education law and regulations (Law, 2002). The "Decision on Education System Reform" announced in 1985 stipulates that the governments of various levels are obliged to maintain the growth of the investment to education. The growth of education expenditure of government at various levels is required to be faster than the growth of fiscal revenue. However, the growth rate of total education appropriation of central and local governments in 1996 and 1997 were still lower than that of budgetary revenue, even the obligation was reiterated in the subsequent policy documents such as "Strategy of China's Education Reform and Development" announced in 1993. From 1999 to 2001 the central government itself failed to fulfil this obligation (Table 5). In most of the years in the 1990s, China's fiscal appropriation to education continuously grew with a lower rate compared with the growth of the budgetary revenue.

In short there are opportunities here for win-win situations. The EU will as we argued in the previous section have to rely increasingly on foreign talent; China on the other hand has not succeeded yet in bringing its education level in some of the less developed regions and provinces up to world standards.

Protection of Intellectual and Industrial Property

Since the 1990s the issue of protection of IPR has not only been an economic and juridical dilemma for China's central and local governments, it has also represented a significant economic concern for international business and political concern for many governments of developed countries. The piracy problem in China has provoked much dispute between the Chinese government and its western counterparts, particularly between China and the US (Oksenberg et al., 1996). Estimates of piracy and infringement of IPR in China are only available from industry interest group such as International Intellectual Property Alliance and Business Software Alliance. Because of the lack of the third party's supporting statistics, the estimated figures issued in their annual reports should be assessed carefully. According to Business Software Alliance (2003), China's piracy rate showed modest improvement since 1994. Nevertheless, China had still the second highest piracy rate, i.e. 92 percent, in the world after Vietnam.

In their in-depth analysis of China's IPR protection issue from the perspective of politics and law, Oksenberg et al. (1996) examine the cultural and historical tradition of the IPR protection in China. They blame the Confucian tradition and the policy of the government in most of the time of the 20th century, particularly in the Mao Era (1949-1976) for China's piracy problem. Bearing in mind that China aims to foster innovation activities in national R&D institutions and build up the technological competitiveness of domestic enterprises in the international market, improving the IPR system and enforcing IPR protection are the unavoidable choices for China's policy makers.

Contrary to the US who has, in line with its industry interest in the software and content sectors, been very vocal about China's IPR infringements, the EU could take a more cooperation attitude on this manner, helping China in establishing an IPR system more in line with the European tradition than with the US one. In doing so, the EU could bring to the forefront the need for open access to science and other forms of "creative commons" and open source, rather than allowing, under US (business) interests, intellectual property to become enlarged to include an increasing number of activities beyond industrial artefacts. The policy discussions in Europe on a number of controversial issues such as the so-called software patent (computer implemented inventions), would be areas in which mutual insights and exchanges could form a basis for a common IPR regime between the EU and China.

To summarize, by recognizing the importance of investments in human resource and R&D, better protection of intellectual property rights and supporting indigenous R&D and innovation efforts, China's central government seems to follow its own adapted ambitious Lisbon strategy (March 2006) for nurturing 'home-grown' innovation over the next decades. The concrete goals set in the blueprint for 2006-2020 include bringing the ratio of gross expenditure on R&D to GDP to 2.5 percent in 2020, seeing technological progress contribute 60 percent of economic growth, growing business expenditures in R&D to twice as much as expenditures on technology transfer (as the

degree of dependence on foreign technology will become reduced below the level of 30 percent), and increasing the number of invention patents granted to Chinese citizens and the citation of international scientific papers so that both will rank among the top five in the world (State Council, 2006).

In this sense both the EU and China are focusing on the same broad strategy of bringing economic development and social welfare to their citizens, no matter whether they will actually fully achieve the goals set out in their respective Lisbon strategies. The scope for mutual learning, for mutual advice for win-win opportunities is without any doubt high.

Conclusions

Fifty years after the creation of what became the European Union, there is an urgent need for a new European Lisbon Agenda, preparing the EU for globalization. It should address as a matter of priority the international, external challenges with which Europe is likely to be confronted in the decades to come. Above in section 2, we listed on the side of the EU three areas which should be central in such a new, external Lisbon strategy: international trade in services, internationalization of research networking, access to brains and talent. The most recent survey on Western multinationals with their headquarters in the US and Europe revealed that about 70 percent of the respondents expected an increase in R&D employment in China in the next three years, and some 40 percent anticipated an expansion in India (Thursby and Thursby, 2006). As geographical boundaries have become blurred with regard to the R&D activities of such MNEs, the generation and diffusion of advanced knowledge will not be restricted merely in the developed world, but will increasingly take place in emerging economies such as Brazil, Russia, India and China.

Surprisingly when looking in somewhat more detail at China, it appears that the country has in a certain way its own Lisbon agenda with its own priorities and challenges. As argued in section 3, the governments in emerging economies such as China strived to absorb globally advanced technology, knowledge and talents by welcoming a huge flow of foreign investment and provide incentives to domestic and foreign firms to innovate within its geographical territory, a strategy very much reminiscent of Europe's own internal Lisbon agenda. And just as in the case of the EU, the goals set out in the Chinese indigenous innovation strategy for 2006-2020 emphasize the contribution of technological progress to economic development, of R&D activities in enterprises and knowledge creation more generally to society. The selected specific Chinese policy challenges briefly reviewed in section 3: the regional disparity, the industrial transformation and the deepening of industry-academy relationship will undoubtedly spur the knowledge production and exploitation in China as much as they would do in Europe. In short the scope for comparative study, for mutual learning from each others' experience, even for joint initiatives, is substantial.

As we have tried to show here, the time has come for the EU to reposition Lisbon as Europe's natural historical "gate" to the rest of the world: the starting point of an externally oriented Europe as opposed to the Europe of the old Rome Treaty whereby Rome represents in a certain way also historically the internally oriented Europe of the last 50 years. Such repositioning of Lisbon will have to recognize more than ever that innovation and the shifts in global demand taking place today, have to play a central role in European and in national debates about the allocation of resources to science and technology, about knowledge access and diffusion, about innovation.

Given the increasingly global nature of the social, economic, environmental, demographic problems Europe is currently confronted with, a unilateral focus on the strengthening of knowledge and innovation activities carried out within Europe with the aim of improving European competitiveness reflects in a certain way a somewhat out-dated "Eurocentric" approach. It does not do justice to the much broader societal and global impact on European citizen's welfare exerted by knowledge accumulation. In a growing number of research fields, European welfare will in the long term be directly influenced not so much by the development of local knowledge, its international

commercial exploitation and intellectual appropriation, but by global access to such knowledge, the development of joint global standards and the rapid world-wide diffusion of such new technologies to other, non-EU countries.

The need for a shift in thinking and policy making towards the external dimensions of Lisbon is, in other words, essential. In a certain sense, this need should not so much be based on the actual facts and figures on the growing intensity of the EU's external relationships in trade, financial, investment or knowledge flows, whatever the dramatic growth of such flows since Lisbon 2000, but on opportunities and similar global challenges. The global challenges confronting Europe and China, we believe call for shared solutions. Shared solutions in the creation of new knowledge and the diffusion of existing knowledge addressing some of the most urgent global problems: climate change and sustainable development; infant mortality, infectious diseases, HIV and more broadly health; water access and desertification; poverty and malnutrition, urbanization and rural development. From this perspective the need for the externalization of European member states' Lisbon knowledge strategy can be easily summarized. What is today probably least needed, yet most funded, is intra-European, and more broadly "North-North" shared research; by contrast what is most needed in view of the global problems listed above, is North-South shared research and knowledge diffusion.

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